

LETTER

An in situ high-pressure NMR study of sodium coordination environment compressibility in albite glass

SARAH J. GAUDIO^{1,*}, TRENTON G. EDWARDS² AND SABYASACHI SEN²

¹Department of Earth and Planetary Sciences, University of California, Davis, California 95616, U.S.A.

²Division of Materials Science and Engineering, University of California, Davis, California 95616, U.S.A.

ABSTRACT

The pressure-dependent modification of the Na-O coordination environment in albite glass is studied in situ to 2 GPa using high-pressure solid-state ²³Na nuclear magnetic resonance spectroscopy. Compression of the glass at ambient-temperature results in shortening of the Na-O bond distance. The concomitant decrease in volume of the local Na-O coordination environment alone can account for the bulk compressibility of albite glass at 300 K. These results provide the first direct experimental evidence of a collapse of the open aluminosilicate framework that helps explain previously reported densification of aluminosilicate glasses and liquids at relatively low pressures without accompanying change in the average coordination number of the network forming Al and Si cations. Such structural changes at relatively low pressures may have far reaching implications for the mechanistic understanding of compressibility and viscosity anomalies characteristic of open tetrahedral aluminosilicate network glasses and melts of geological importance.

Keywords: In situ, high pressure, NMR, glass structure, compressibility, albite, sodium aluminosilicate